Organisms & Populations

- Living world → fascinatingly diverse / amazingly complex. ★ v. imp.
- Various levels of Biological organisation → macromolecules → cells → tissues → organs → individual organisms → Population → communities → ecosystem → biomes
- Why does bulbul sing? → Birds need to communicate with mate during the breeding season.

* ECOLOGY → subject which studies interaction → b/w organisms; b/w organisms & physical factors (abiotic)
  - concerned at 4 levels of Biological organisation → organisms ✓, populations ✓ → We study this
  - communities
  - biomes

Organism & Its Environment

* Ecology at Organismic level → is essentially physiological Ecology → which tries to understand "Diff. organisms are adapted to environment" in terms of survival & Reproduction.

* Rotation of our planet around sun + Tilt of its axis → causes Annual variations in intensity of T & duration of T → resulting in Seasons

Annual variation in precipitation (includes both rain & snow) + These variations → account for → Formation of major biomes → desert, Rain forest, Tundra

* Regional variation + Local variations → within each biome → -e leads to formation of Wide variety of habitats

* Life also exists in Extreme & harsh habitats
  - not only in favourable habitats
  - Scorching Rajasthan desert
  - Rain soaked meghalaya forest
  - Deep trenches (ocean)
  - Torrential streams
  - Permafrost (snow laden) polar region
  - High mountain tops
  - Intestine of humans, Stinking compost pits, Thermal springs → habitat to 100s of species of microbes.

* Key elements (that lead to so much variation in physical cond. & chemical cond. of different habitats) → Temperature, Water, Light, Soil

Physico-chemical (abiotic) components + Biotic components (with which org. interact: pathogen, parasite, predators, competitors) → characterise → Habitat of organisms completely

Organisms through natural selection evolve to adaptations to optimise → survival & Reproduction → in habitat

NICHE – Each organism has → invariably defined range of conditions it can tolerate
Diversity in resources it utilises
Distinct functional role in ecological system.

MAJOR ABIOTIC FACTORS

Temperature

Most imp. ecologically relevant environmental factor.

* Avg. Temp on LAND
  - varies seasonally
  - ↓ progressively as we move from equator towards poles & from plains to mountain tops
* It ranges from,
  - Subzero levels (in polar areas) & high altitude
  - to → > 50°C in tropical deserts in summer

Unique habitats as
- thermal springs
- Deep sea hydrothermal vents

→ where avg. temp. >> 100°C (exceeds)

* Mango tree → cannot grow in Temperate country (Canada, Germany)
* Snow Leopards → Not found in Kerala forests
* Tuna fish → Rarely caught beyond tropical latitudes in ocean
* Temp → affects Kinetic energy of Enzyme & through it
  - Metabolic activity
  - Other physiological functions of organism
* Eurythermal – tolerate & thrive in wide range of temp (Fish)
* Stenothermal – restricted to narrow range of temp. (Vast majority)

Water

Another most imp factor.

Life on earth originated from water → Unsustainable without water

Its availability → Limited in deserts.

only special adaptation that make it possible for organism to live here.

Productivity, Distribution of plants → Heavily dependant on water

* Organism living in Lake, oceans, river face water related problems ↓ in terms of quality of water
  - chemical composition
  - pH.
* The salt concentration ↓ measured in Salinity in parts per thousand.

Inland water	Sea	Hypersaline lagoons
< 5	30-35	>100

* Euryhaline (some) → Organisms tolerant of wide range of salinities.
* Stenohaline (most) → Restricted to narrow range of salinities.

Many fresh water org cannot live in long sea water & vice versa due to OSMOTIC PROBLEMS.

Light

Imp of light due to photosynthesis in particularly autotrophs.

Many species of small plants
- herbs
- shrubs

→ growing in forests → adapted to photosynthesise in LOW LIGHT COND. ↓ bcz they are constantly overshadowed by Tall, canopied trees.

Many plants → dependent on sunlight to meet their photoperiodic requirement (Flowering)

Many animals Use the
- diurnal variation
- seasonal variation

→ in light intensity & duration (photoperiod) as cues for timing
- foraging
- Reproductive activities
- Migratory activities

Availability of light on land is closely linked with Temp ← Heat of sun is source for both

Deep (>500m) in ocean ↓ environment is dark ↓ inhabitants not aware of celestial source of energy — Sun

* Spectral quality of solar radiation. imp for life.

Soil

Nature & Properties of soil → vary at different places

Dependent on:
- Weathering process
- Soil is transported OR sedimentary
- how soil development occurred

Various characteristics as
- soil composition
- grain size
- aggregation

→ determines
- Percolation
- Water holding capacity

These characteristics along with
- pH
- mineral composition
- Topography

determine to a large extent → Vegetation in area → this in turn dictates type of animal that can be supported.

Similarly, in Aquatic Environment → Sediment characteristics often determine → Type of benthic animal that can thrive there.

el of thermal
olerance of different
species
↓ determine to large extent
Geographical distribution

UV component of spectrum harmful to many organisms.

* Not all colour components of visible spectrum available for marine plants at diff depths in ocean.

Response to Abiotic Factors

★ Why highly variable external environment should bother organisms after all? → One would expect that during the course of million of years of their existence.

Many species would have evolved ← Relatively constant internal (within body) environment. ← that permits ← All ← Biochemic reaction, Physiological reaction → to proceed with maximum efficiency

thus → enhance "overall fitness" of species ← this constancy could be in terms of: Optimal temperature; Osmotic concentration of Body fluids.

* Organism should be → maintain constancy of its environmental (internal) (PROCESS — HOMEOSTASIS) despite varying external environmental conditions that tend to upset homeostasis.

Eg. Person's homeostasis maintained by ARTIFICIAL MEANS (not physiological)

* ~~Person's work best at~~ ~~25°C~~ (wishes to maintain it)

using AC in summer, using heater in winter ← could be achieved by ← [scorchingly heat, freezing cold] ← even when

★ REGULATE: Some organisms → able to maintain homeostasis

constant Body Temp, constant Osmotic concentration ← ensures ← physiological, Behavioural (sometimes) ← by

* All birds & Mammals; Very few Lower vertebrate, Invertebrate species → capable of → thermoregulation, osmoregulation

→ large reason for "success" of mammals believed by EVOLUTIONARY BIOLOGISTS

Mechanisms (used by most mammals) → to regulate → Body temp is similar to that we humans use

PLANTS — ~~Mechanism to maintain internal temperatures~~

37°C ← we maintain

In SUMMER → when outside temp > Body temp → we sweat profusely by evaporating cooling. → Brings Temp ↓

In WINTER → when outside temp ↓↓ than 37°C, we shiver (a kind of exercise) produce heat → Body Temp ↑

☆ CONFORM → Overwhelming

- majority animals → 99%
- nearly all plants

Constant internal environment ← cannot maintain

Aquatic animals → osmotic concentration of Body fluids changes with that of ambient
- air
- water osmotic concentration

These → animals / plants → simply conformers

Why these can't thermoregulate?

Thermoregulation → energetically expensive → for many organisms particularly small animals ← shrews, humming birds

Heat Loss / Gain is a function of surface area → Since small animals have Larger surface area relative to Volume. → they tend to Lose body heat very fast when its cold outside → then they have to expend much energy to generate Body heat through metabolism

This is main reason → why small animals RARELY found in polar regions.

During Course of EVOLUTION → Costs / Benefits → of maintaining constant internal environment taken into consideration.

Some species have evolved → ability to regulate (over limited range) beyond which they simply confirm

If Stressful External conditions are localised OR remain for short duration. → organism have 2 other alternatives

MIGRATE

Organism can move away temporarily from stressful habitat to Hospitable area → return when → Stressful period over.

In human analogy → move from Delhi → Shimla for duration of summer.

Many animals (particularly BIRDS) → during winter undertake → Long distance migrations → to Hospitable areas

SUSPEND

In Bacteria, Fungi, Lower plants → various kinds of thick walled spores formed → help them to survive unfavourable condition which → these germinate on availability of suitable environment.

In higher plants → Seeds, some other vegetative / reproductive structures → serve to tide over periods of stress

Besides dispersal they germinate to form new plants under favourable → moisture, temperature

every winter → Famous KEOLADO NATIONAL PARK (Bharatpur) in Rajasthan → hosts → thousands of migratory birds → coming from Siberia (& other extremely cold northern region)

Seeds suspend by → reducing metabolic activity / going into a state of dormancy.

IF ANIMALS, UNABLE TO MIGRATE might avoid stress by escaping into time

Bears → undergo → HIBERNATION (in winter)

some → snails / fish → undergo → AESTIVATION (in summer) to avoid summer related problems: heat, dessication

Many Zooplanktons species in → lakes / ponds → under unfavourable condition enter DIPAUSE (a stage of suspended development)

ADAPTATIONS

Some cope with extreme condition respond through

- Physiological adjustments
- Behavioural (temporary migrating to less stressful habitat)

These responses are → adaptations

ADAPTATION ← hence

morphological / physiological / Behavioural ← attribute of organism

that enable organism to → survive & reproduce → in its → habitat

Many adaptations
① has evolved over long evolutionary time
② genetically fixed ← and are

In KANGAROO RAT (in North American Deserts)

- In absence of external source of water → capable of meeting all its water requirement → through → Internal Fat Oxidation (H2O is by product here)
- also has → capability to concentrate its urine → so that → minimal volume of water → used to → remove excretory products

Many desert plants have →
- thick cuticle on leaf surface
- stomata arranged in deep pits (sunken)

→ to minimise water loss through transpiration

- have → special photosynthetic pathway (CAM) → enables stomata to remain closed during day time

Desert plants like OPUNTIA has → ~~Leaves~~
- have → reduced leaf → spines → Photosynthetic function taken over by → Flattened stems

Mammals from → Colder climate → generally have → short ears / short limbs → to minimise heat loss

→ ALLEN'S RULE

In polar seas, acquatic mammals like SEALS have thick layer of (blubber) below their skin that acts INSULATOR reduces loss of body heat

Some organisms → Posses adaptation that are physiological which allow them to Respond quickly to a stressful condition

near manali, Leh

if you had been to High Altitude places (Rohtang Pass) (> 3500m)

you must have experienced ALTITUDE SICKNESS. symptoms include nausea, fatigue, heart palpitation

because:

In Low atmospheric pressure of high altitude.

Body does not get enough O_2

↑↑ RBC production

↓ Binding affinity of haemoglobin

↑↑ breathing rate

by

Gradually get acclimatised by compensation ↓↓ O_2 availability

In most animals → Metabolic Reactions hence all → physiological function proceed optimally in narrow temper range (in humans 37°C)

But → there are microbes (archaebacteria) that flourish in

- HOT springs
- Deep sea hydrothermal vents

Many fishes thrive in → Antarctic Waters. where avg. temp. always below zero.

- Large variety of marine invertebrates
- Fishes

→ Living at great depths in ocean where pressure > 100 time normal pressure

Organism living in such extreme environments show → Fascinating array of Biochemical Adaptations

Some organisms show behavioural response to cope up with variations in environment

DESERT LIZARDS lack physiological ability that mammals have to deal with high temp of their habitat.

but manage to keep Body temp fairly constant by behavioural means

- They bask in sun & absorb heat when their body temp. drops below comfort zone.
- move to shade when ambient temp. starts ↑↑

Some species are capable of → Burrowing into the soil to → hide / escape from above ground heat

POPULATIONS

In nature we rarely find → Isolated single individuals of any species.

Population Attributes

Majority of them live in → well defined geographical area.

→ share / compete for similar resources

→ Potentially interbreed

→ thus constitute → population

Interbreeding implies sexual reproduction

But

Grp of individuals resulting from asexual Reproduction → is also considered → POPULATION (for purpose of ecological studies)

Example of Population

- Cormorants in a wetland
- Rats in an abandoned dwelling
- Teakwood trees in a forest tract
- Bact in a culture plate
- Lotus plants in a pond

Natural selection operates at → Population level (to evolve desired traits)

Population ecology → links → ecology → to → population genetics / evolution.

Population has certain attributes whereas, individual organism does not.

Population has → Death rate / Birth rate

Individual organism has → Death / Birth

these rates refer to → Per capita births & deaths.

Rates expressed as change in no's (↓/↑) → w.r.t member of population.

Example → In a pond — 20 lotus — last year

Newly added — 8

Total now — 28

Birth Rate = $\frac{8}{20}$ = 0.4 offspring per lotus per year

In a laboratory — 40 fruitflies

Died — 4 of them

Death Rate = $\frac{4}{40}$ = 0.1 individuals per fruitfly per week

* Another attribute of population → SEX RATIO → 60 : 40 → ♀ : ♂

(Individual can be male / female)

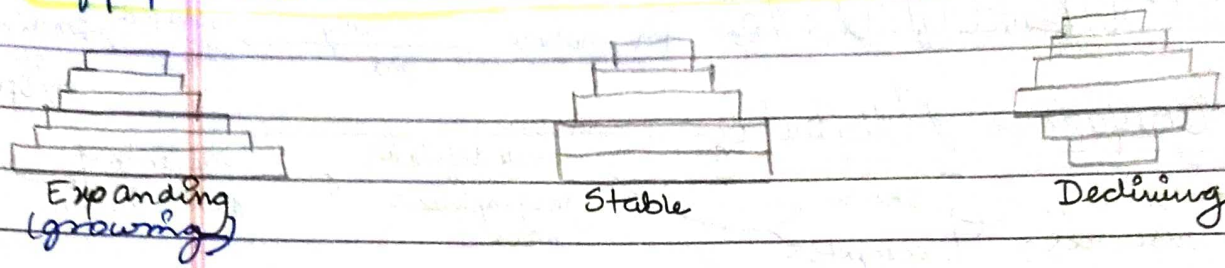
* Population → at any given time → is composed of individuals of → different ages

AGE PYRAMID — [Age distribution (percentage individuals of a given age/age grp)] → plotted for the population.

resulting structure

For human population → age pyramids generally show age distribution ♀ ♂

Shape of pyramids reflects the growth status of population.



* Size of population ~~tells us a lot about~~ → its status in habitat

* Whatever ecological processes we wish to investigate in population

Outcome of competition with another species. | Impact of a predator | Effect of pesticide application.

↓ we always evaluate them

in terms of any change in the population size.

↓ size, in nature could be

as low as < 10 (Sibelian cranes at Bharatpur wetlands in any year) | go into millions (Chlamydomonas in a pond)

Population size, technically called → POPULATION DENSITY designated as N.

need not necessarily be measured in no.s.

although Total number generally most appropriate measure of population density

in some cases this is → Meaningless / Difficult to determine

Example In an area,

Carrot grass – 200
Banyan tree – 1
} → this means population density of Banyan tree is low relative to carrot grass. → amounts to → underestimating enormous role of Banyan tree in a community.

measure of the population size ← in more meaningful ← Percent cover, Biomass ← in such cases

Total no. is again not an easily adoptable measure if population size is huge & counting is impossible / very time consuming.

* For certain ecological investigations → no need to know absolute population densities

Relative densities → serve purpose equally well.

Example → Fish caught/per trap —(good enough to measure)→ its Total population density in the lake.

Tiger census → in → national parks / Tiger reserves is often based on → pug marks / Fecal pellets

* We are mostly obliged, to estimate population sizes indirectly without counting or seeing them.

POPULATION GROWTH

Size of a population for → any species → ~~Static parameter~~

↓ changing with time

↓ Depending on various factors including → food availability / predation pressure / adverse weather.

* In fact, these changes in population density gives us idea whether population is → flourishing / declining

* 4 basic processes, due to which population fluctuates:

↑ population

Population density (N) ↓ expressed in → No. / biomass / % cover (depending on species)

B

i) Natality → no. of births during a given period in a population – added to initial density.

ii) Immigration → no. of individuals of same species that have come into habitat from elsewhere during time period underconstruction

I

D

↓ population

i) Mortality → no. of deaths in population during a given time period.

ii) Emmigration: no of individuals of population who left the habitat & gone somewhere else else during that time consideration.

E

$$N = N_t + [(B + I) - (D + E)]$$

N ← population density; N_t → initial population density

* Under normal conditions, B & D → most important factors influencing population density.

Special conditions ← ~~normal condn~~ ← Other 2 factors important only under

New habitat being colonised (Immigration more imp than birth rates)

Growth Models

EXPONENTIAL GROWTH

Resource → food, space } availability essential for unimpeded growth of population.

* If resource are → unlimited in a habitat → each species has the ability to realise fully its innate potential (BIOTIC POTENTIAL) → to grow in no. (as DARWIN observed while developing his theory of Natural selection)

Exponential ← population then grows in an geometric fashion

N → population size / population density

Birth rates → per capita births (not total no.) → (b)

Death rates → per capita death rate → (d)

$\frac{dN}{dt}$ (increase or decrease) → change during unit time period +

$\frac{dN}{dt} = (b-d)N$ ☆ $b-d = r$

$\frac{dN}{dt} = rN$

open

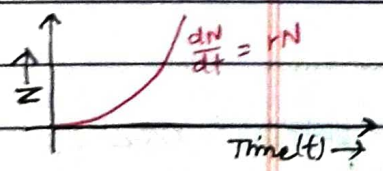
r → intrinsic rate of natural increase → measure of → inherent potential of population to grow

very important parameter chosen for assessing the impacts of any biotic factors / abiotic factors on population growth

Curve Obtained → J shaped ⇒ $N_t = N_0 e^{rt}$

N_t → population density at time t

N_0 → population density at t = 0.



Any species → growing exponentially under ideal unlimited resources conditions → enormous population densities in short time can reach

* Darwin shared → how slow growing animal → ELEPHANT → could reach enormous numbers

Checks. ← In absence of

LOGISTIC GROWTH

open

No population of any species in nature has its disposal unlimited resources → Exponential growth. ← to permit

this leads to competition b/w individuals for limited resources → Eventually Fittest one will survive & reproduce

* Government of many countries realised the fact → introduced various restrictions & (with views to) limit human population growth.

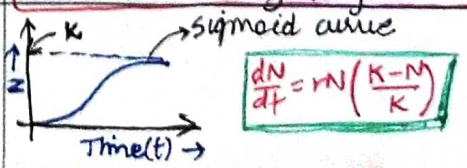
* In nature → given habitat has enough resources → to support maximum possible number → beyond which No further growth possible

This limit as → nature's carrying capacity (K) for that species in that habitat

Population growing in habitat with limited resources.

Initially – LAG PHASE → followed by phases of acceleration, deceleration → finally → asymptote. (when population density reaches K)

Verhulst - Pearl Logistic growth → sigmoid curve

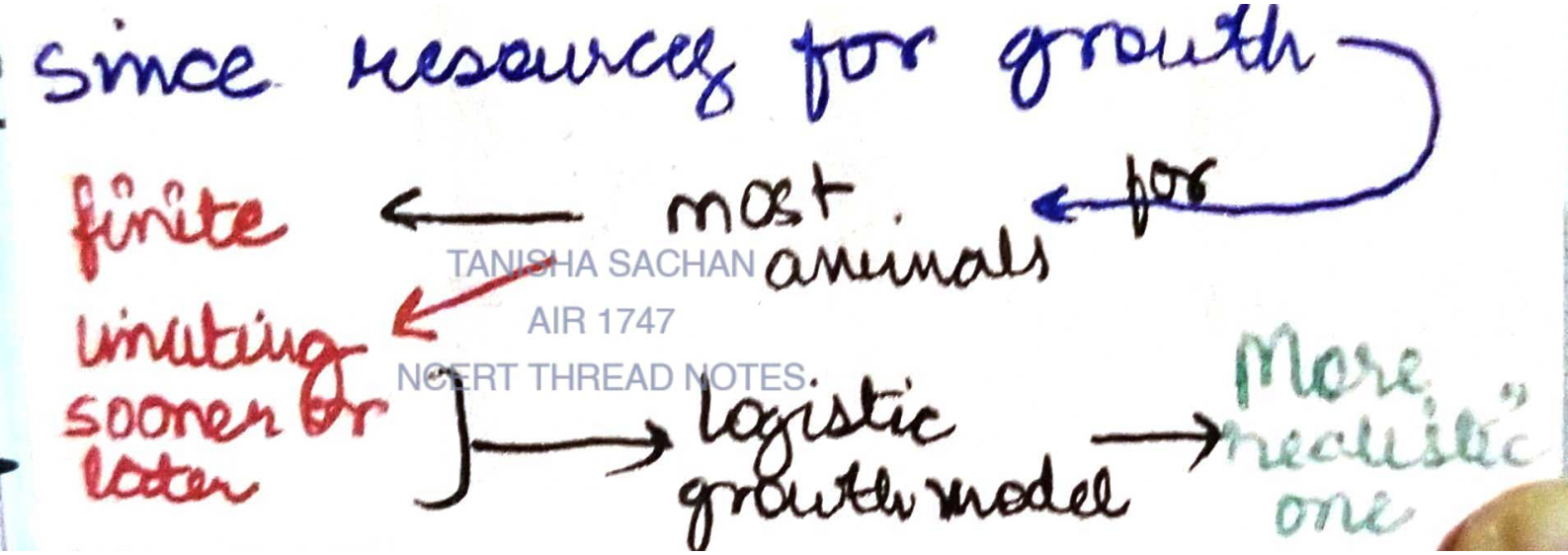


Value of r : For →

Norway Rat – 0.015

Flour Beetle – 0.12

Human population in INDIA (1981) – 0.0205



Life History Variation

Populations → evolve to maximise → their Reproductive fitness
(Darwinian fitness)
in habitat which they live ← higher value

- Under particular set of Selection pressures → organisms evolve towards → MOST EFFICIENT REPRODUCTIVE STRATEGY

- Some organism → breed once times during lifetime → Pacific salmon fish, Bamboo
  → breed many times during lifetime → most birds, mammals

* Some organism produce → Large no small sized offspring → Oysters, Pelagic fishes
  → Small no large sized offspring → birds, mammals

Ecologists suggests → Life history traits of organism have evolved → in relation to constraints imposed by → biotic components, abiotic components

Important area of Research (conducted by ECOLOGISTS) → Evolution of life history traits in different species

habitat in which they live ← of

POPULATION INTERACTIONS

For any species, minimal requirement is → one more species on which it can feed

* Even plant species → who can make their own food → cannot survive alone

Animals, Plants, Microbes → do not & cannot live in isolation → but interact in various ways → to form → Biological community

need soil microbes for → Breaking down organic matter in soil & return inorganic nutrients for absorption

need animals for → pollination

Even in minimal communities → many interactive linkages exist → although not readily apparent

Population Interactions

* Interspecific Interaction arise from → interaction of population of 2 different species

they could be → beneficial / detrimental / neutral

to → one species or both species

Species A	species B	Name of interaction
+	+	Mutualism
−	−	Competition
+	−	Predation
+	−	Parasitism
+	0	Commensalism
−	0	Amensalism

* * In parasitism → parasite benefits * detrimental to → host
* * In predation → predator benefits * detrimental to → prey

1) Predation
2) Parasitism
3) Commensalism

share a common characteristic → interacting species live closely together

PREDATION → nature's way of transferring the energy (fixed by plants) to higher trophic levels

Predator	Prey
Lion	Deer
Sparrow	seed

* Imp point

* Although animals eating plants categorised separately as herbivores in broad ecological content
they are not → very different from Predators

Predators are → 'conduits' for energy transfer across trophic levels

PREDATORS keep → population under control

For predators → prey species could achieve very high population density → can cause → Ecosystem Instability

* When certain EXOTIC SPECIES are introduced in → A geographical area → they become → invasive & start spreading fast bc → Invaded land does not have natural predators

Example – Prickly pear Cactus introduced in Australia in Early 1920's

Date : Page :

caused a havoc by spreading rapidly into million of hectares of rangeland

FINALLY Invasive Cactus was brought under control by introducing Cactus feeding predator (a moth) from its natural habitat introduced into the country

* BIOLOGICAL CONTROL METHODS adopted in Agricultural Pest control.

BASED ON ability of predator to regulate prey population

* Predators help in maintaining specie diversity in a community by reducing the intensity of competition among competing prey species

EXAMPLE

In the Rocky Intertidal communities of American Pacific coast the STARFISH (Imp predator)

DISASTER in FIELD EXPERIMENT When all the Starfish were removed from endosed intertidal area result more than 10 species of invertebrates (i.e. >10) got extinct in a year due to INTERSPECIFIC COMPETION

* In predator too efficient it overexploits the prey then prey might become extinct following it Predator will also become extinct for Lack of food.

this is why Predators in nature are prudent

* Prey species have evolved various defenses to lessen impact of predation :

Some species of insects frogs cryptically coloured (camouflaged) to avoid being detected by predator.

Some are poisonous & therefore avoided by predators.

Monarch Butterfly is highly distasteful to its predator → bird. because of special chemical present in body

* Butterfly acquires this chemical in Caterpillar stage by feeding on poisonous weed

* For plants, HERBIVORES - predators → ~25% of all insects are known to phytophagous feeding on plant sap / other parts of plant

Problem is severe for plants bcz they cannot run away from their predators

PLANTS, therefore have evolved an astonishing variety of
- Morphological defences
- Chemical defences

Acacia, Cactus, Thorns (most common morphological defence)

herbivores against

Many plants produce & store chemicals that make herbivore sick when eaten
- inhibit feeding
- inhibit digestion
- Disrupt reproduction
- kill it

EXAMPLE

WEED - CALOTROPIS growing in abandoned fields

this plant produces highly poisonous CARDIAC GLYCOSIDES

→ this is why cattle/goats never browse on this plant.

* Wide variety of chemical substances we extract from Plants on commercial scale
- Nicotine
- caffeine
- quinine
- Strychine
- Opium

NEET 2020

Defences against Grazers / Browsers ← prod. by plants

COMPETITION

* When, DARWIN spoke about → Struggle for
- existence
- survival of the fittest

in → nature

acc^n to Darwin ← Organic evolution ← potent force in Interspecific competition

he was convinced that

Competition occurs when → closely related species compete for → same resources (that are limiting)

↳ THIS NOT COMPLETELY TRUE !!

Firstly

Totally unrelated species
↓ can also
compete for same resources
↓
EXAMPLE

Some shallow South american lake → Visiting flamingoes & resident fishes
↓
compete for same/common food. (Zooplankton in lake)

Secondly

Resources need not be limited !!

In INTERFERENCE COMPETITION
feeding efficiency of species might be reduced due to
- interfering presence
- inhibiting presence

of other species
↓ even when
- Space
- food

→ abundant.

Competition — best defined as → process in which
Fitness of 1 species (measured in terms of its 'r' - intrinsic rate) significantly lowered << presence of other species

Relatively easy → to demonstrate in laboratory experiments as Gause & other experimental ecologists did!
↓ when resources are limited
Competitively superior species → will eventually → eliminate the other species

BUT → Evidence for such competitive exclusion occuring in nature not always conclusive.
→ Strong persuasive circumstantial evidence does exist however in some cases.

EXAMPLE ← Abingdon Tortoise in Galapagos Island → became extinct (within a decade)
Due to greater browsing efficiency of goats
Goats were introduced after on island

→ Another evidence for occurence of competition in nature comes from COMPETITIVE RELEASE

A species whose distribution is restricted to small geographical area
↓ based on the presence of Competitively superior species.
↓ that species found to expand its distributional range dramatically when competing species removed in experiments

Connell's Elegant Field Experiment → showed from → In Rocky Sea coasts of Scotland

Larger + competitively superior → barnacle (Balanus)

dominates (Intertidal area) → Excludes smaller barnacle (Chathamalus) from that zone.

In General → Herbivore & Plants → more affected by → Competition.

Carnivores ← than

GAUSE's → COMPETITIVE EXCLUSION PRINCIPLE

↓ states

2 closely related species competing for same resources

cannot → co-exist indefinitely

Competitively inferior one & → will be → eliminated eventually

This is true when resources are limiting otherwise not true.

More recent studies → do not support such → Gross generalisation about competition

They do not rule out the occurence of interspecific competition in nature

They point out that → Species facing competition might evolve mechanism that promote co-existence (rather than exclusion)

one such mechanism → RESOURCE PARTITIONING

If 2 species compete for same resource → they can avoid → competition by → choosing (for instance)

different times for feeding

different foraging pattern

Mc Arthur showed 5 closely related species of Warblers living on the same tree were able to avoid competition & co-exist due to behavioural differences in foraging activity

PARASITISM

Parasitic mode ensures → free lodging, meals → it is not surprising that parasitism has evolved in ~~so many~~ taxonomic groups

from plants to higher vertebrates

* Many parasites → host specific (they can parasitise only a single species of host) → in such a way that they co-evolve

Parasite has to evolve mechanism to counteract/neutralise them. ← then ← if host evolves special mechanism for rejecting/resisting the parasite. ← means that

In order to be successful with the same host species

* In accordance with their life style → Parasites evolved special adaptation.

- Loss of unnecessary sense organs
- Presence of adhesive organs OR suckers (to cling onto the host)
- Loss of digestive system
- high reproductive capacity

Life cycle of parasites → complex → involving 1 or 2 intermediate hosts / vectors → to facilitate parasitisation of its primary host.

* Human Liver Fluke (Trematode parasite) depends on → 2 intermediate hosts → snail, fish

* Malarial Parasite needs → Mosquito (vector) to spread to other hosts.

* Majority of parasite harms the host.

- Reduce survival, Growth, Reproduction
- Reduce population density (N)
- Render host vulnerable to predation by making host physically weak.

Ectoparasites → Parasite feeding on → External surface of → host organism

- Lice on humans
- Ticks on dogs
- Copepods → on many marine fishes
- Cuscuta → on hedge plants
  - lost → Chlorophyll → Leaves → in course of evolution
  - derives nutrition from host plants

* Female Mosquito → not considered → ~~Parasite~~
  - although needs blood for reproduction

Endoparasite → Parasites living inside → Host body at different sides → Liver, Kidney, Lungs, RBC

- Life cycle more complex
- their
  - morphological features
  - Anatomical features
  - → greatly simplified
- bcz of → Extreme speciation
- emphasis on → Reproductive potential

BROOD PARASITISM in birds

→ Fascinating example of parasitism

Parasitic Bird → in attack → lays its eggs in → nest of host & let host incubate them.

During the course of evolution → Parasitic Bird's eggs have evolved resemblance to → Host's egg in
- size
- colour

→ to reduce → chances of host bird detecting → Foreign eggs & ejecting them from the nest

Cuckoo (Koel) → Brood parasitism → in breeding season from spring to summer.

COMMENSALISM

* ORCHIDS growing as an → Epiphyte on → Mango tree
* BARNACLES growing on → Back of → Whale

→ nor benefited neither harmed

* Cattle egret & Grazing Cattle in close association
  - classic example of commensalism

in farmed Rural areas. → Egrets always forage

Date : / /

cattle ← close to where cattle are grazing (bcz)

insects ← stir up / flush out ← cattle as they move

from → vegetation (that otherwise be difficult for egrets to find & catch.)

* Interaction b/w Sea anemone & clown fish (lives among them)

Sea anemone → has stinging tentacle

clown fish → no benefit by losing clown fish

Fish gets → protection from → predators (which stay away from stinging tentacles)

MUTUALISM

* Lichens → Intimate Mutualistic Relationship b/w fungi & photosynth. algae/cyanobacteria

Fungi → help in absorption of essential nutrients from soil.

Plants → provide fungi with energy yielding carbohydrate.

Fungi → Roots of higher plants. → mycorrhiza

* Most → spectacular / evolutionarily fascinating examples of mutualism is Plant - Animal Relationships

* Plants needs the help of animals for pollinating their flowers & dispersing their seeds.

pollinators for Pollen, Nectar in form of paid (fees) ← animals have to be

Seed dispersers for fruits: juicy, nutritious

* But such Mutually Beneficial System should be safeguarded against cheaters.

pollination without aiding ← Animals toying to steal nectar ← eg.

Evolutions of { flower, pollinator species } → tightly linked with one another.

* Given Fig Species → can be pollinated by → "Partner" Wasp species (& no other species)

♀ wasps → uses → fruits → not only as → ovipositing (egg laying) → developing seeds within fruits for nourishing → larvae

* Wasp → pollinates → Fig Inflorescence → while searching for → suitable egg-laying sites → in return for pollination → Fig offers wasps some of its developing seeds (as food for developing larvae)

* ORCHIDS show → bewildering diversity of Floral patterns, many of which have evolved to attract Right pollinator insects → bees, Bumblebees → & ensure → guaranteed pollination.

Not all orchids offer rewards.

Mediterranean Orchid (Ophrys) employs "Sexual deceit" to get pollination done by bees

One petal of flower bears → uncanny resemblance to ♀ bee (in size, colour, markings) → ♂ bee is attracted to → what it perceives as ♀ → then pseudocopulates with flower → during which → dusted with pollens from flowers → when same bee pseudocopulates with another flower → transfers Pollen → thus pollinates the flower

→ Hence co-evolution operates.

If females bee colour patterns change even slightly for any reason during evolution, pollination success will be reduced / unless orchid flowers co-evolve to maintain resemblance of petal to ♀ bee.

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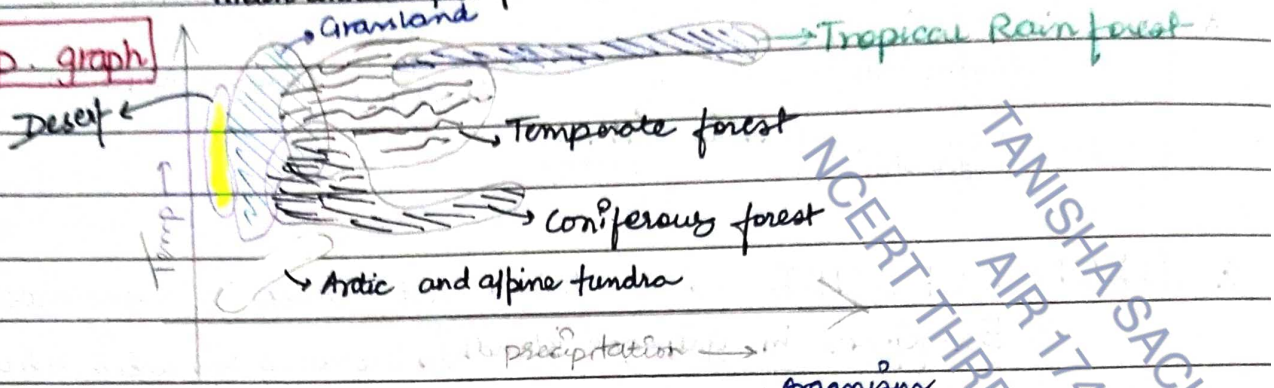
* Biome with ① minimum variation in annual temp. → Tropical Rain forest.
② Maximum variation in mean annual precipitation

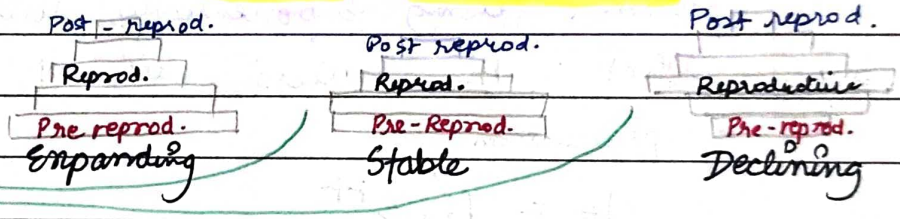
Imp. graph



* Ecology is concerned with 4 levels only → Organism, population, communities, Biomes

* Major Biomes of India → Tropical Rain forest, Deciduous forest, Desert, Sea coast

* Age pyramids →



→ Remember the order of pre-repr. & reprod. & post reprod. no° of people in it

* Breed once a life time → Pacific Salmon fish (Not artic)
Bamboo plant

* Niche - distinct functional role in ecological system.

* Niche Overlap — indicates → sharing of one or more resources b/w two species

• KEYSTONE SPECIES → small proportion of total Biomass of community
Huge impact on community's organisation & survival

* Lichen, Mycorrhiza — are → Symbiotic + Mutualism

* symbiosis & mutualism almost same

* Brood Parasitism — is not → true parasitism

* In a population, unrestricted Reproductive capacity — Biotic Potential

* Association of individuals of different species living in same habitat & having functional interactions — BIOTIC COMMUNITY

* Only → Birds, Mammals → homeothermal.

* Arctic Alpine tundra is at → Minimum annual temp zone.

* Vegetation in area determined by all → soil composition, grain size, aggregation, pH, mineral composition, Topography → determine → percolation, water holding capacity

* r → very imp. parameter for assessing impacts of any → biotic / abiotic factor on population growth.

* EXOTIC SPECIES → one that is not native to given area.
  Ex. Goats in galpagos islands → exotic if they were introduced

* Biome with minimum variation in mean annual precipitation → Desert.

* An organism of Benthic Zone – Decomposing Bacteria.

Q. If a population growing exponentially doubles in size in 3 yrs, what is the intrinsic rate of increase (r) of population?

$$N_t = N_0 e^{rt}$$

$$2x = x e^{3r}$$

$$2 = e^{3r}$$

$$\log 2 = 3r \log e$$

$$r = \frac{\log 2}{3 \log e} = \frac{0.301}{3 \times 0.434} = 0.2311$$

Imp Q